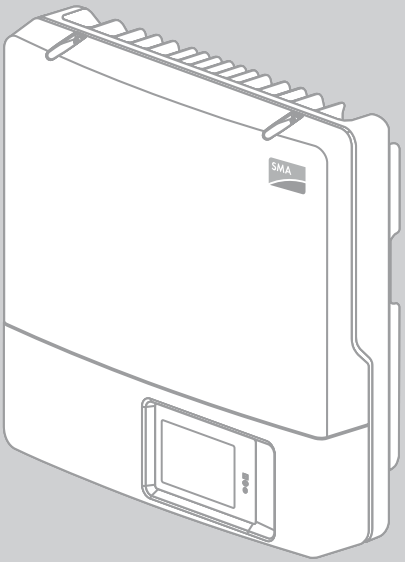
Service Manual

SUNNY BOY 3000TL / 3600TL / 4000TL / 5000TL



SB3-5TL-21-SG-en-10 | Version 1.0

AMERICAN ENGLISH

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1 Information on this Document

This document describes how to rectify certain errors and how to replace defective components. This document is a supplement to the documentation that is provided with each product. It does not replace any locally applicable standards or directives. Read and observe all documentation supplied with the product.

Validity

This document is valid for the following device types from firmware version 2.55:

- SB 3000TL-21 (Sunny Boy 3000TL)
- SB 3600TL-21 (Sunny Boy 3600TL)
- SB 4000TL-21 (Sunny Boy 4000TL)
- SB 5000TL-21 (Sunny Boy 5000TL)

Target Group

This document is intended for qualified persons. Only qualified persons are allowed to perform the tasks described in this manual (see Section 2.1 "Skills of Qualified Persons", page 7).

Symbols

Symbol	Explanation
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage
i	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
✖	A problem that could occur

Nomenclature

Complete designation	Designation in this document
Electronic Solar Switch	ESS
SMA *Bluetooth*® Wireless Technology	*Bluetooth*
Sunny Boy	Inverter, product

2 Safety

2.1 Skills of Qualified Persons

Only qualified persons are allowed to perform the tasks marked in this document with a warning symbol and the caption "Qualified person". Qualified persons must have the following skills:

- Knowledge of how an inverter works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and systems
- Training in the installation and commissioning of electrical devices and systems
- Knowledge of the applicable standards and directives
- Knowledge of and adherence to this document and all safety precautions

2.2 Safety Precautions

This section contains safety precautions that must be observed at all times when working on or with the product.

To prevent personal injury or property damage and to ensure long-term operation of the product, read this section carefully and follow all safety precautions at all times.

⚠ DANGER

Danger to life due to high voltages when working on the inverter

The inverter must be mounted, installed and commissioned by qualified persons only. Troubleshooting must be performed by qualified persons only.

- Only operate the inverter in a closed state.
- Do not touch uninsulated cable ends.
- The inverter must be mounted, installed and commissioned by qualified persons with the appropriate skills only.
- If an error occurs, have it rectified by a qualified person.

⚠ DANGER

Danger to life due to high voltages

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors and the live components of the inverter. Touching the DC conductors or the live components can lead to lethal electric shocks.

- Do not touch the DC conductors.
- Do not touch any live components of the inverter.
- Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document (see Section 2.3, page 9).

⚠ DANGER

Danger to life due to electric shock

Touching an ungrounded PV module or an array frame can cause a fatal electric shock.

- Connect and ground the PV modules, array frame and electrically conductive surfaces so that there is continuous conduction. Observe the applicable local regulations.

⚠ WARNING

Risk of burns due to hot enclosure parts

Some parts of the enclosure can get hot during operation.

- Do not touch any parts other than the lower enclosure lid of the inverter during operation.

NOTICE

Damage to the seal of the enclosure lids during sub-zero conditions

If you open the upper and lower enclosure lid during sub-zero conditions, the sealing of the enclosure can be damaged. Moisture can penetrate the inverter.

- Only open the inverter when the ambient temperature is at least -5 °C.
- If a layer of ice has formed on the seal of the lid in sub-zero conditions, remove it prior to opening the enclosure lids of the inverter (e.g. by melting the ice with warm air). Observe the corresponding safety regulations.

NOTICE

Damage to the inverter due to electrostatic discharge

Touching electronic components can cause damage to or destroy the inverter through electrostatic discharge.

- Ground yourself before touching any components.

NOTICE

Damage to the display or the type label due to the use of cleaning agents

- If the inverter is dirty, clean the enclosure, the cooling fins, the enclosure lid, the type label, the display and the LEDs using only clean water and a cloth.

2.3 Disconnecting the Inverter from Voltage Sources

⚠ QUALIFIED PERSON

Prior to performing any work on the inverter always disconnect it from all voltage sources as described in this section.

NOTICE

Damage to the seal of the enclosure lids during sub-zero conditions

If you open the upper and lower enclosure lid during sub-zero conditions, the sealing of the enclosure can be damaged. Moisture can penetrate the inverter.

- Only open the inverter when the ambient temperature is at least -5 °C.
- If a layer of ice has formed on the seal of the lid in sub-zero conditions, remove it prior to opening the enclosure lids of the inverter (e.g. by melting the ice with warm air). Observe the corresponding safety regulations.

NOTICE

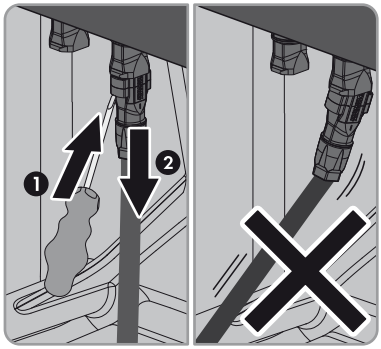
Destruction of the measuring device due to overvoltage

- Only use measuring devices with a DC input voltage range up to 1,000 V.

Procedure:

1. Disconnect the circuit breaker and secure against reconnection.
2. If an external DC load-break switch is available, switch off the DC load-break switch and secure against reconnection.
3. If an ESS is plugged in, remove the ESS.
4. If a multifunction relay is used, switch off the load supply voltage.
5. Wait until the LEDs, display and if necessary, the load connected to the multifunction relay, are switched off.
6. Use a current clamp to ensure that no current is present in the DC cables.
7. Remove all six screws of the lower enclosure lid using an Allen key (AF 3) and remove the enclosure lid.

8. Unlock and remove all DC connectors. Insert a slotted screwdriver or an angled screwdriver (blade width 3.5 mm) into one of the slide slots and pull the DC connectors out downwards. Do not pull on the cable.



9. Ensure that no voltage is present at the DC inputs of the inverter.
10. Ensure that no voltage is present between **L** and **N** and **L** and **PE** on the AC connecting terminal plate using a suitable measuring device. Insert the test probe (maximum diameter: 2 mm) in each round opening of the terminal.
11. Flip the display up to have more space to make the measurement. Loosen the screw on the display to do this.

    ☑ The display clicks into place.
12. Ensure that there is no voltage between any terminal of the multifunction relay and **PE** of the AC connecting terminal plate.
13. ***NOTICE***

    Damage to the inverter due to electrostatic discharge

    The internal components of the inverter can be irreparably damaged by electrostatic discharge.

    - Ground yourself before touching any components.

3 Cleaning the Inverter

NOTICE

Damage to the display or the type label due to the use of cleaning agents

- If the inverter is dirty, clean the enclosure, the cooling fins, the enclosure lid, the type label, the display and the LEDs using only clean water and a cloth.

- If the cooling fins on the rear of the enclosure are dirty, clean them using a soft brush.
- If the air ducts on the top of the inverter are dirty, clean them using a soft brush.

4 Error Messages

Event number	Display message, cause and corrective measures
101 to 103	**Grid fault** The line voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid. **Corrective measures:** • Check whether the line voltage at the connection point of the inverter is permanently in the permissible range. If the line voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits. If the line voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line.
202 to 203, 205	**Grid fault** The utility grid has been disconnected, the AC cable is damaged or the line voltage at the connection point of the inverter is too low. The inverter has disconnected from the utility grid. **Corrective measures:** • Ensure that the circuit breaker is switched on. • Ensure that the AC cable is not damaged. • Ensure that the AC cable is correctly connected. • Check whether the line voltage at the connection point of the inverter is permanently in the permissible range. If the line voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits. If the line voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line.

Event number	Display message, cause and corrective measures
301	**Grid fault** The ten-minute average line voltage is no longer within the permissible range. The line voltage or grid impedance at the connection point is too high. The inverter disconnects from the utility grid to comply with the power quality. **Corrective measures:** • Check whether the line voltage at the connection point of the inverter is permanently in the permissible range. If the line voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits. If the line voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line.
401	**Grid fault** The inverter is no longer in grid-parallel operation. The inverter has stopped feeding into the utility grid. **Corrective measures:** • Check the grid connection for significant, short-term frequency fluctuations.
501	**Grid fault** The power frequency is not within the permissible range. The inverter has disconnected from the utility grid. **Corrective measures:** • If possible, check the power frequency and observe how often fluctuations occur. If fluctuations occur frequently and this message is displayed often, contact the grid operator and request permission to change the operating parameters of the inverter. If the grid operator gives his approval, discuss any changes to the operating parameters with the SMA Service Line.
601	**Grid fault** The inverter has detected an excessively high proportion of direct current in the line current. **Corrective measures:** • Check the grid connection for direct current. • If this message is displayed frequently, contact the grid operator and check whether the monitoring limiting value on the inverter can be raised.

Event number	Display message, cause and corrective measures
701	**Frq. not permitted > Check parameter** The power frequency is not within the permissible range. The inverter has disconnected from the utility grid. **Corrective measures:** • If possible, check the power frequency and observe how often fluctuations occur. If fluctuations occur frequently and this message is displayed often, contact the grid operator and request permission to change the operating parameters of the inverter. If the grid operator gives his approval, discuss any changes to the operating parameters with the SMA Service Line.
801	**Waiting for grid voltage > Grid failure > Check fuse** The AC cable is not correctly connected or the country data set is not correctly configured. **Corrective measures:** • Ensure that the AC cable is correctly connected (see operating manual of the inverter). • Ensure that the country data set has been configured correctly. • Check the fuse.
901	**PE conn. missing > Check connection** PE is not correctly connected. **Corrective measures:** • Ensure that PE is correctly connected (see operating manual of the inverter).
1001	**L / N swapped > Check connection** The connection of L and N is swapped. **Corrective measures:** • Ensure that L and N are correctly connected (see operating manual of the inverter).
1501	**Reconnection fault grid** The changed country data set or the value of an operating parameter you have set does not correspond to the local requirements. The inverter cannot connect to the utility grid. **Corrective measures:** • Ensure that the country data set has been configured correctly. Check the setting of the rotary switches **A** and **B** or select the operating parameter **Set country standard** and check the value.

Event number	Display message, cause and corrective measures
3301 to 3303	**Unstable operation** The ten-minute average line voltage is no longer within the permissible range. The line voltage or grid impedance at the connection point is too high. The inverter disconnects from the utility grid to comply with the power quality. **Corrective measures:** • Check whether the line voltage at the connection point of the inverter is permanently in the permissible range. If the line voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits. If the line voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line.
3304	**Gen. output too low** The DC output of the PV array is too low. The inverter cannot connect to the utility grid. **Corrective measures:** • Wait for higher irradiation. • If this message is displayed frequently with medium irradiation, ensure that the PV system is correctly rated and the PV array correctly wired.
3401 to 3402	**DC overvoltage > Disconnect generator** Overvoltage at DC input. This can destroy the inverter. This message is additionally highlighted by rapid flashing of the backlight. **Corrective measures:** • **Immediately** disconnect the inverter from all voltage sources (see Section 2.3, page 9). • Check whether the DC voltage is below the maximum input voltage of the inverter. If the DC voltage is below the maximum input voltage of the inverter, reconnect the DC connectors to the inverter. • If the DC voltage is above the maximum input voltage of the inverter, ensure that the PV array has been correctly rated or contact the installer of the PV array. • If this message is repeated frequently, contact the SMA Service Line.
3501	**Insulation failure > Check generator** The inverter has detected a ground fault in the PV array. **Corrective measures:** • Check the PV system for ground faults (see service manual at www.SMA-Solar.com).

Event number	Display message, cause and corrective measures
3601	**High discharge curr. > Check generator** The leakage current of the inverter and the PV array is too high. There is a ground fault, a residual current or a malfunction. The inverter interrupts feed-in operation immediately after exceeding a limiting value. When the fault is eliminated, the inverter automatically reconnects to the utility grid. **Corrective measures:** • Check the PV system for ground faults (see service manual at www.SMA-Solar.com).
3701	**Resid.curr.too.high > Check generator** The inverter has detected a residual current due to temporary grounding of the PV array. **Corrective measures:** • Check the PV system for ground faults (see service manual at www.SMA-Solar.com).
3801 to 3802	**DC overcurrent > Check generator** Overcurrent at the DC input. The inverter briefly interrupts feed-in. **Corrective measures:** • If this message is displayed frequently, ensure that the PV array has been correctly rated and wired.
3901 to 3902	**Waiting for DC start conditions > Start cond. not met** The feed-in conditions for the utility grid have not been met. **Corrective measures:** • Wait for higher irradiation. • If this message is displayed frequently in the morning, increase the voltage limit for starting feed-in. Change the parameter **Critical voltage to start feed-in**. • If this message is displayed frequently with medium irradiation, ensure that the PV array is correctly rated.
6001 to 6438	**Self diagnosis > Interference device** The cause must be determined by the SMA Service Line. **Corrective measures:** • Contact the SMA Service Line.

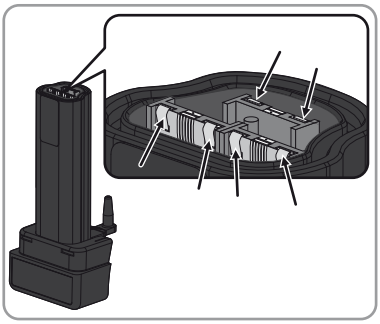
Event number	Display message, cause and corrective measures
6501 to 6502	**Self diagnosis > Overtemperature** The inverter has switched off due to excessive temperatures. **Corrective measures:** • Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush. • Ensure that the inverter has sufficient ventilation.
7008	**Disturbance sensor display temperature** The cause must be determined by the SMA Service Line. **Corrective measures:** • Contact the SMA Service Line.
7101	**SD card defective** The SD card is not formatted. **Corrective measures:** • Reformat the SD card. • Resave the files to the SD card.
7102	**Parameter file not found or defective** The parameter file was not found or is defective. The update failed. The inverter continues feeding power into the grid. **Corrective measures:** • Copy the parameter file to the directory :\PARASET on the SD card drive.
7105	**Param. setting failed** It was not possible to set the parameter via the SD card. The inverter continues feeding power into the grid. **Corrective measures:** • Check the parameters for valid values. • Ensure change rights via SMA Grid Guard code.
7106	**Update file defect.** Update file on the SD card is faulty. **Corrective measures:** • Reformat the SD card. • Resave the files to the SD card.
7110	**No update file found** No update file has been found. **Corrective measures:** • Copy the update file in the SD card folder. Select the folder **\UPDATE**.

Event number	Display message, cause and corrective measures
7201 to 7202	**Data stor. not poss.** Internal error. The inverter continues to feed into the utility grid. **Corrective measures:** • Contact the SMA Service Line.
7303	**Update main CPU failed** The cause must be determined by the SMA Service Line. **Corrective measures:** • Contact the SMA Service Line.
7305	**Update RS485I module failed** Internal error. The inverter continues to feed into the utility grid. **Corrective measures:** • Retry update. • If this message is displayed again, contact the SMA Service Line.
7307	**Update BT failed** Internal error. The inverter continues to feed into the utility grid. **Corrective measures:** • Retry update. • If this message is displayed again, contact the SMA Service Line.
7311	**Update language table failed** Internal error. The inverter continues to feed into the utility grid. **Corrective measures:** • Retry update. • If this message is displayed again, contact the SMA Service Line.
7401	**Varistor defective** At least one of the thermally monitored varistors is defective. **Corrective measures:** • Check the function of the varistors (see service manual at www.SMA-Solar.com).
7508	**External fan fault** The external fan is defective or blocked. **Corrective measures:** • Ensure that the fan is clean. • Ensure that the external fan is correctly connected.

Event number	Display message, cause and corrective measures
8001	**Derating occurred** The inverter has reduced its power output for more than ten minutes due to excessive temperature. **Corrective measures:** • Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush. • Ensure that the inverter has sufficient ventilation.
8801 to 8803	**No display** The cause must be determined by the SMA Service Line. **Corrective measures:** • Contact the SMA Service Line.
9005	**Changing grid param. not possible > Ensure DC supply** This error can have the following causes: • The selected rotary switch setting for the country configuration is not programmed. • The parameters to be changed are protected. • The DC voltage at the DC input is not sufficient to run the main CPU. **Corrective measures:** • Ensure that the country data set has been configured correctly. • Enter the SMA Grid Guard code. • Ensure that sufficient DC voltage is available (green LED glowing or flashing).

5 Checking the ESS for Wear

1. Disconnect the inverter from all voltage sources (see Section 2.3, page 9).
2. Check the metal mounting tabs inside the ESS for discoloration or damage.



If the metal mounting tabs show brown discoloration or are damaged, order a new ESS from SMA Solar Technology AG and have the ESS replaced.

6 Checking the PV System for Ground Faults

If the inverter displays the event numbers **3501**, **3601** or **3701**, there could be a ground fault. The electrical insulation from the PV system to ground is defective or insufficient.

NOTICE

Destruction of the measuring device due to overvoltage

- Only use measuring devices with a DC input voltage range up to 1,000 V.

Proceed as follows to check each string in the PV system for ground faults.

Procedure:

1. **⚠ DANGER**

   Danger to life due to high voltages

   - Disconnect the inverter from all voltage sources (see Section 2.3, page 9).

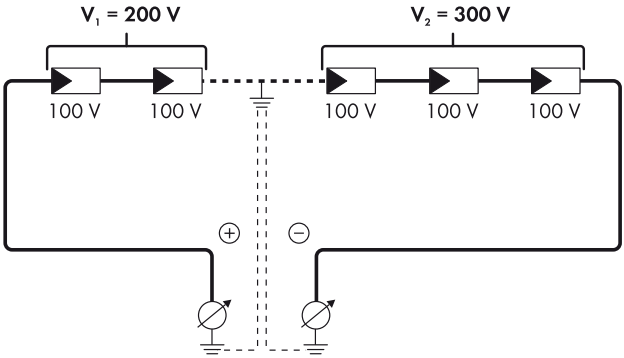
2. Measure the voltages:
   - Measure the voltages between the positive terminal and the ground potential (PE).
   - Measure the voltages between the negative terminal and the ground potential (PE).
   - Measure the voltages between the positive and negative terminals.

     If the following results are present at the same time, there is a ground fault in the PV system.
   - All measured voltages are stable.
   - The sum of the two voltages to ground potential is approximately equal to the voltage between the positive and negative terminals.
   - Determine the location of the ground fault via the ratio of the two measured voltages.
   - Eliminate the ground fault.

     If there is no ground fault and the message is still displayed, contact the SMA Service Line.

Example: Location of the ground fault

The example shows a ground fault between the second and third PV module.



3. Commission the inverter (see inverter documentation).

7 Checking the Function of the Varistors

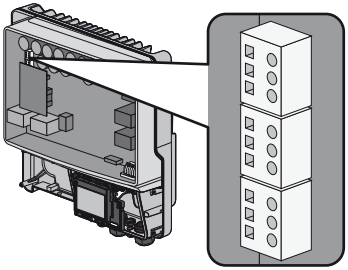


Figure 1: Varistors inside the inverter

If the inverter displays event number **7401**, one of the varistors is probably defective.
Check the function of each varistor as described below.

NOTICE

Destruction of the inverter due to overvoltage

If varistors are missing, the inverter is no longer protected against overvoltage.

- Do not operate the inverter without varistors in PV systems with a high risk of overvoltages.
- Do not recommission the inverter until the defective varistors have been replaced.

NOTICE

Destruction of the measuring device due to overvoltage

- Only use measuring devices with a DC input voltage range up to 1,000 V.

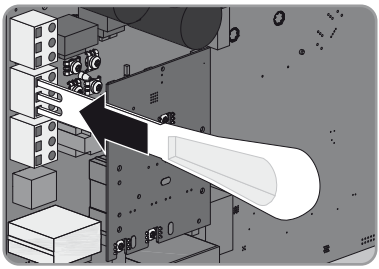
Procedure:

1. Disconnect the inverter from all voltage sources (see Section 2.3 "Disconnecting the Inverter from Voltage Sources", page 9).
2. **⚠ DANGER**

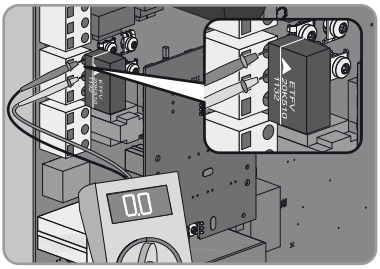
   Danger to life due to high voltages

   - Wait five minutes before opening the upper enclosure lid.
3. Loosen the screws of the upper enclosure lid using an Allen key (AF 4) and remove the enclosure lid.

4. Position the insertion tool in the clamping contacts of the connecting terminal plate.



5. Remove the varistor from the connecting terminal plate.
6. Use a multimeter to measure whether there is a conductive connection between the upper and the middle varistor lead.



If there is no conductive connection, the varistor is defective. SMA Solar Technology AG recommends replacing all varistors immediately.

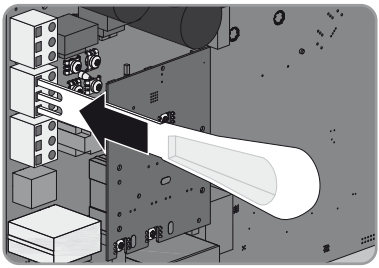
- Order new varistors and insertion tools fromSMA Solar Technology AG.
- If new varistors are available, replace all varistors (see Section 8, page 25).

If a conductive connection is present, contact the SMA Service Line.

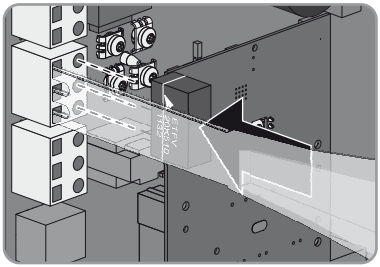
8 Replacing the Varistors

1. Disconnect the inverter from all voltage sources (see Section 2.3, page 9).
2. **⚠ DANGER**

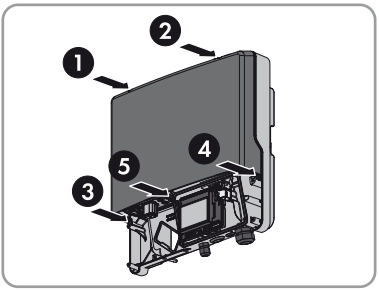
   Danger to life due to high voltages
   - Wait five minutes before opening the upper enclosure lid.
3. Loosen the screws of the upper enclosure lid using an Allen key (AF 4) and remove the enclosure lid.
4. Position the insertion tool in the clamping contacts of the connecting terminal plate.



5. Remove the varistor from the connecting terminal plate.
6. Insert the new varistor into the terminal.
   The labeling on the varistor must point left to the enclosure.



7. Remove the insertion tool from the clamping contacts of the connecting terminal plate.
8. Position the upper enclosure lid with the five screws and conical spring washers on the enclosure and tighten it using an Allen key (AF 4) in the order 1 to 5 (torque: 6 Nm ± 0.3 Nm). The toothing of the conical spring washers must point towards the enclosure lid.



9. Recommission the inverter (see inverter installation manual).

9 Contact

If you have technical problems concerning our products, contact the SMA Service Line.
We need the following information in order to provide you with the necessary assistance:

- Inverter device type
- Inverter serial number
- Inverter firmware version
- Special country-specific settings of the inverter (if applicable)
- Type and number of PV modules connected
- Mounting location and mounting altitude of the inverter
- Three-digit or four-digit event number and display message of the inverter
- Optional equipment, e.g. communication products
- Use of the multifunction relay (if present)

Australia	SMA Australia Pty Ltd. Sydney	Toll free for Australia: 1800 SMA AUS (1800 762 287) International: +61 2 9491 4200
Belgien/ Belgique/ België	SMA Benelux BVBA/SPRL Mecheln	+32 15 286 730
Brasil	Vide España (Espanha)	
Česko	SMA Central & Eastern Europe s.r.o. Praha	+420 235 010 417
Chile	Ver España	
Danmark	Se Deutschland (Tyskland)	
Deutschland	SMA Solar Technology AG Niestetal	Medium Power Solutions Wechselrichter: +49 561 9522-1499 Kommunikation: +49 561 9522-2499 SMS mit „Rückruf“: +49 176 888 222 44
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